ported. There were imported, largely from America, in 1877, 498 head; in 1882, 1,430. Another obstacle which stock-raising must encounter is the difficulty in the way of pasturage. The scant herbage is unfitted for blooded stock, and the raising of grasses or grain will be unprofitable. In the inland regions the farmers of small means often keep a horse or a cow, not for work, but solely for the manure derived from it. It shows strikingly the lack of capital everywhere so prevalent. When a farmer finds an ox or a cow too costly, he buys a superannuated or broken-down pack-horse that can hardly stand, feeds it, and carefully collects the manure.

Notwithstanding all the obstacles, the importation and improvement of cattle in Japan, the author believes, should certainly not be abandoned. By a proper study of natural conditions, stock-raising may do much toward bettering the circumstances of the Japanese people.

A BOOK-MANUFACTORY IN ANCIENT ROME.

IN the *Illustrirtes schweizerisches unterhaltungsblatt für stenographen*, the *Publishers' weekly* finds an interesting account of the production of books in ancient Rome. It is stated therein, that, notwithstanding the Romans had no printing-presses, books were at that time produced much more quickly and in larger numbers than most modern works. Paper was used which was almost woven out of the fibre of the Egyptian papyrus, which grows to a height of ten feet, and which has given its name to paper. A Roman residing in Egypt assures us that the yield of his paper-manufactory would be sufficient to support an army, and whole shiploads of paper were sent from Egypt to Rome. Before books of any description were reproduced in large numbers, they were read mostly either in private circles or publicly, so that the author could adopt suggestions for the improvement of his work. Wealthy Romans used to own a large number of slaves for all kinds of services, which rendered labor cheap, as they cost nothing in many cases, and had only to be supported. They were mostly prisoners of war, the pick of nations, and often more cultivated (especially the Greeks) than their masters. They were consequently also employed in the education of Roman boys. The works of authors were dictated to a number of slaves, women also being employed for that purpose. Even among freemen and liberated slaves the desire to obtain employment became so great, that hundreds of willing hands could be had for writing books at a very low rate of wages. The instruction imparted in the workshops of Roman publishers necessitated a regular course of training, which was to teach the apprentices an easy and elegant handwriting. If a publisher had at his disposal, say, a hundred writers, and reckoning the working-day at ten hours, a document which took an hour to write would be multiplied in the course of a day to a thousand copies. The writers became in time expert to such a degree that they combined quickness with elegance. It must also be added that in cases where speed was the first consideration, the use of stenographic contractions became general, and we possess illustrations of their employment in the old manuscripts still in existence. We are also informed that both readers and copyists were instructed and trained, the former in the solution, the latter in the application, of contractions. Their object was to copy works as quickly as possible, the use of full words being only resorted to for the best works. The above brief account demonstrates the fact that the Romans made the nearest approach to the invention of printing, although they never attained to it. The movable stamps of iron or other metals used by the Romans for marking earthenware vessels or other utensils also prove this. But the art of rapid writing, which was perfected by them to an unusual degree, counteracted a further development, while the number of slaves and other willing hands at disposal, by which means the most astonishing results were obtained, operated in the same direction.

THE HEATING-POWER OF GAS.

THE introduction of the gas-engine and the increased use of ordinary illuminating-gas for domestic heating-purposes, renders its calorific properties of far more importance than they were a few years ago, says *Engineering*. The experiments made on this subject do not appear to have been very exhaustive, and, if we may judge by those we are about to quote, have not always been carried out with due care. M. Aimé Witz, whose researches in connection with the gas-engine are well known, has lately made some experiments in order to determine with greater accuracy the heating-power in ordinary French illuminating-gas. His apparatus was composed of an explosion-cylinder of nickel-plated steel 2.36 inches internal diameter and 3.54 inches high. The thickness of the metal was .079 of an inch. The top and bottom covers were tightly screwed on, rendering the chamber air-tight. Through the top cover a wire passed, and on the bottom was a valve for filling or emptying the receptacle. This cylinder was contained in a vessel 4 inches in diameter and

8 inches high. This acted as a calorimeter, the amount of water required to charge it being 1.76 pints. In order to charge the explosion-cylinder, it is first filled with mercury, which is allowed to run out, the explosive mixture of air and gas taking its place. The explosion was caused by an electric current passing through the wire in the top cover. The result of a large number of experiments led to the conclusion that the average calorific power of well-purified illuminating-gas, as generally stipulated for by the concessions of French gas companies, is about 5,200 calories per cubic metre. This is equal to 584 British units per cubic foot. The standard of 6,000 calories, hitherto generally accepted, would therefore be too high. M. Witz's experiments more nearly accord with those recently made by Mr. Dugald Clerk, who estimated 504,888 and 489,268 foot-pounds per cubic foot as the mechanical equivalents of Manchester and London gas. This would correspond to 5,640 and 5,372 calories per cubic metre. M. Witz found that the calorific power of gas supplied from the same works varied considerably, at different seasons of the year ranging between 4,719 and 5,425 calories; but the average of tests showed that the difference between the gas supplied by various works was not great. The purification of the gas reduces the calorific power by more than 5 per cent. The gas produced during the last hour of a charge is inferior in heating-power to that obtained during the first hour. The heating-power of gas may be increased 77 per cent by carburation; but the gasoline employed becomes rapidly less volatile, and, when reduced to one-fourth its volume, its enriching-power is only 34 per cent. The details of the experiments, which appear to have been made with every precaution to insure accuracy, have been given in the *Annales de chimie et de physique* for 1885, and are quoted in the abstracts of foreign papers of the Institution of civil engineers.

REMSEN'S INTRODUCTION TO THE STUDY OF CHEMISTRY.

THE difficulty encountered by those who desire to have science which is true science taught in the high schools and academies of this country has been the lack of good teachers and of suitable books. Gradually, however, the books are appearing. Such volumes as those of Gray on botany, Guyot on physical geography, Dana on elementary geology, Martin on physiology, and others which we might name, are excellent examples of the skill with which men of acknowledged distinction as scientific men have prepared text-books adapted to youth in their teens. The influence of such books is to awaken a love of the observation of nature, and to show the scholar how, from simple phenomena, he may proceed to those which are difficult and complex. The improved condition of American school-books is sure to have a lasting effect upon the future citizens of this country. Already the increasing love of scientific studies and pursuits is manifested in a hundred ways.

Professor Remsen has now prepared a chemistry which is intended for those who are beginning the study. No one will question his learning or his experience. For many years his daily round of the laboratory has made him familiar with the perplexities and difficulties which are encountered by students of every grade, — the bright and the dull, the immature and the adult. It sounds paradoxical to hear him declare at the beginning of his work, that, in face of the serious difficulties which lie in the way of a purely scientific treatment of chemistry, he thinks it possible to treat the subject more scientifically than is customary, and thus to make it easier of comprehension.

He therefore lays down as his guiding principle a desire to develop a scientific habit of thought; and this cannot be accomplished either by haphazard, and disconnected experimenting, or by considering the profoundest theories before the student is fitted to comprehend them. The proper course is to begin with an orderly sequence of laboratory lessons, to be performed, if possible, by every pupil for himself, and, if this is not possible, then by the teacher in the presence of a very small class, — not more than ten or a dozen persons.

This volume is therefore prepared as a manual for the laboratory of beginners. The cost of the requisite apparatus is not large, and is quite within the allowances of all superior schools, either for girls or boys. The beginning of the course is very easy; but it soon grows harder, and requires for its conduct a teacher who has himself been trained in laboratory methods. The self-taught chemist will be a very awkward guide. Such an instructor will find his work made delightful by the orderly, progressive steps which are marked out for the class to follow. At frequent intervals questions are interposed which the student himself must answer from his own observation and reading. Enough information is given to make his investigations easy and profitable, not enough to stifle independent thought. The author's doctrine is that a badly performed experiment is as objectionable as a bad recitation or a badly written exercise.

Introduction to the study of chemistry. By IRA REMSEN. New York, *Holt*, 1886. 12°.